

Cases will be met with in which the ureter and bladder cannot be brought together without undue traction, and will demand good judgment and skill to surmount the difficulty. In one case Howard Kelly loosened the bladder from its anterior attachments, and in that way gained three centimeters. Loosening the kidney from its bed will also give about three or four centimeters, and if necessary both procedures might be resorted to, thereby obtaining an approximation of from six to seven centimeters. If this is not sufficient, we must resort to the more difficult and serious operation of using a piece of isolated intestine to bridge over the gap between the ureter and the bladder, as advised and done experimentally by Fabri, D'Urso and myself.

The following patient was operated upon on account of a uretero-vaginal fistula following vaginal hysterectomy:

Mrs. R., aged 28 years, nullipara, had noticed a lump in the left lower abdomen for several months, which appeared and disappeared without any apparent reason, but did not cause any pain.

In September, 1903, while on a visit to Portland, she was taken suddenly sick with chills and fever and violent pain in the lower abdomen. The physician who saw her made a diagnosis of pus tube and fibroid tumors of the uterus. The patient was removed to the hospital and operated upon. Several pus sacs were said to have been evacuated, and the uterus removed per vaginam on account of two small fibroids. Six days after the hysterectomy which was done with clamps, fecal matter began to pass per vaginam, and continued for ten days, when it almost stopped; but urine began to flow at about that time, and continued to do so until the time I operated on her, November 14, 1903.

Examination made the day before operation showed two large fluctuating masses in the pelvis, the left one being larger than the right, neither being very tender to the touch. Vaginal examination disclosed the absence of the cervix, and on the left side of the vault a small opening about two centimeters deep, funnel-shaped and bleeding on being touched. Urine was seen flowing from the bottom of the cavity. Attempts to pass fine bougies or ureteral catheters were futile, and only provoked bleeding and caused pain. On the posterior vaginal wall at the margin of the wound was a small papilla, beneath which a fine probe could be passed into the rectum. Cystoscopic examination showed urine flowing from the right ureter, but none from the left, and a ureteral sound could be passed only for a distance of one centimeter into the left ureteral orifice. The bladder at the site of the left ureter was pulled toward the back and left side, undoubtedly by cicatricial contraction. The urine collected from the vagina for one hour measured one ounce, and the same amount was drawn from the bladder during the same time. The patient had been taking hexamethylene tetramine for four days, and urine passed from the vagina one hour after the administration of a formalin douche 1-1000 showed no bacteria either by culture or centrifuge, so I concluded that there was as yet no ascending infection. This was remarkable on account of the fact that, even though fecal matter did not pass through the rectal fistula, gas did; and colored solutions injected into the vagina passed into the rectum, showing a valve-like arrangement at the recto-vaginal fistula. This fact made it impracticable to attempt any operation through the vagina; and further, the large masses in the pelvis were better attacked through the abdomen.

The operation was done just two months from the first one. The abdomen was opened in the median line, and it was seen at a glance that the masses were ovarian in character, because the tubes were both intact and lay on top of the tumors. The left one was firmly adherent, and every time an adhesion was separated a pus sac was opened, and near the bottom of the pelvis a small cyst was broken into. Great difficulty was experienced in separating the mass from the cicatricial tissue left from the previous operation, and some of the sac wall had to be left in.

The tumor on the right side was a cyst as large as the fist, and was easily removed. The tissues of the pelvis which were in contact with the tumor of the left side were thoroughly wiped with pads wrung out of formalin solution 1-1000. Search was then made for the left ureter, which proved somewhat deceptive on account of its large size, looking more like the external iliac vein than a ureter, and it was only after finding the vessels a little on one side that I felt sure of the ureter. It was fully one centimeter in diameter. It was dissected down as far as possible without opening the vagina, and a ligature placed at the lowest point. The ureter was cut just above the ligature, and implanted into the bladder in the manner previously described.

There was very little tension at the point of anastomosis and no anchor sutures were required. The abdomen was

closed without drainage, and the patient put to bed, with the head of the bed elevated eighteen inches. A catheter was kept in the bladder for forty-eight hours, the urine being slightly bloody during that period. After that time it discommoded the patient so much that I withdrew it, and ordered the patient to be catheterized every three hours. She felt able to pass water without assistance, however, and was allowed to do so. The amount of urine passed rapidly reached normal, and even exceeded it, and was passed without difficulty, with the exception that the patient felt slight pain at the end of micturition, at a spot corresponding to the point of anastomosis. No bacteria were found at any time subsequent to the operation.

The recto-vaginal fistula was closed at a subsequent operation, and the patient is at the present time in the full enjoyment of perfect health.

Cystoscopic examination two months after implantation of the ureter showed a small dimple at the point of insertion, from which urine could be seen flowing. The ureteral orifice was rather small, barely admitting the tip of a Kelly searcher, but evidently sufficiently patulous to allow the urine to enter the bladder without any obstruction.

The ureteral flaps were not discernable, and this is in accord with my experimental work, which has shown in every instance that the flaps either unite so closely with the bladder wall as to be invisible or else the ureter pulls them up along with the wall, leaving only a dimple to be seen after the lapse of a few months.

[For discussion see May JOURNAL, page 162.]

EXTRACTS FROM RECENT LITERATURE ON FOURTH OF JULY TETANUS.*

By FRANCES LOUISE NEWTON, M. D., Woodland.

HAVE, from my earliest recollections, been interested in tetanus. The children that I knew warned each other against stepping on a rusty nail for fear of lockjaw, just as they taught each other the kinds of mushrooms that were poisonous and those that were edible. My interest has been much increased within the past year by the numerous articles that have appeared in the medical journals upon the subject, especially *The Journal of the American Medical Association*, whose attention was attracted by the appalling loss of life through the celebration of the Fourth of July recorded in the daily papers throughout the country. Warnings were not wanting, for the newspapers retold the experiences of previous years; how many lives were lost through accidents of the Fourth, and how many more had succumbed to the tetanus epidemic that follows in its train. Parents were warned both of the dangers in the use of toy pistols and the necessity of the proper care of the wounds that they might produce. The responsibility of municipal authorities was pointed out. Attention was called to innumerable ordinances controlling the sale of toy pistols to minors and the discharge of firearms within the city limits of the municipality. Assertions were made that if existing laws were enforced by the police, the events of preceding years could be modified, if not eliminated.

Nor has the public alone been warned. Hardly a medical journal in the country failed to speak of the topic at the approach of the Fourth, both last year and this, and to urge the necessity of thorough surgical treatment of blank cartridge wounds, as well as the desirability of the prophylactic use of antitoxin. Much credit is due the *Journal* for investigating and tabulating the results of the accidents that occurred all over the United States from celebrating the Fourth last year. The list of dead and injured will probably not be any less this year.

ACCIDENTS ON JULY 4, 1903.

Deaths from tetanus.....	406
Deaths from other causes.....	60
Non-fatal injuries	3,983
Total persons dead or injured.....	4,449
Tetanus cases from blank cartridges.....	363
Tetanus cases from all other known causes..	29
Other injuries from blank cartridges and fireworks	2,461
Other injuries from fireworks, powder, cannon, and all other known causes.....	1,364

*Read before the Yolo County Society for Medical Improvement.

The *Journal* was able to learn of but seven recoveries from tetanus, so that the mortality would be well above 95 per cent.

Etiology.—Tetanus is an acute or subacute infectious disease caused by a specific organism, the tetanus bacillus, and characterized by violent, tonic spasms with marked exacerbations and remissions. In almost all cases of tetanus, trauma is a predisposing cause, making a place of entrance for the pathogenic organism. Lacerated and contused wounds, especially where nerves are involved, are favorable for the development of tetanus. Injuries to the hands and feet are apt to permit infection more than are other parts. The disease, however, may follow surgical operations, extraction of teeth, vaccination, burns, insignificant scratches or puncture injuries from splinters, rusty nails, needles, tacks, etc.; and there was an epidemic of tetanus in St. Louis from the use of diphtheria antitoxin manufactured by the City Board of Health; but the tabulated report of the *Journal* shows an overwhelming frequency from the blank cartridge wound—406 out of 466.

Bacteriology.—The tetanus bacillus growing under favorable conditions is a characteristic drumstick-shaped organism, whose peculiar feature is a considerable enlargement at one end, in which enlargement a bright, round spore can be seen. The non-spore-bearing bacilli are long and slender, having rounded ends; are motile, and are numerous when conditions of temperature and environment are favorable. The organism will not grow in the presence of the slightest amount of oxygen, which fact renders its successful cultivation a matter of some difficulty. It stains readily by Gram's method, and with ordinary watery solutions of the aniline colors. The organism is widely distributed in nature. It is almost everywhere to be found—in garden and field soil, in the street dirt of cities, about manure piles and in the foul mud of marshes and river beds. The reason that more people are not infected by this well-nigh omnipresent germ is because it is anaërobic, and is one of the few of those organisms known to be pathogenic to man.

The condition in which tetanus is usually seen depends upon the anaërobic nature of the germ, and the famous rusty nail wound is dangerous, not because of the rust, but because the germ is carried into tissues far removed from air. For the same reason mixed infections are favorable to the development of tetanus, as the other organisms requiring oxygen for their support use up that which may reach them, and so make conditions favorable for the tetanus bacilli. The spores are very resistant to outside influences, retaining their vitality for months or years in a desiccated condition, and not being destroyed in two and a half months when present in putrefying material. Splinters of wood covered with tetanus spores after being kept for eleven years have been found still capable of causing tetanus in mice. Spores will stand exposure to 80 degrees Centigrade for an hour, but are killed by a temperature of 100 degrees Centigrade in five minutes. They resist the action of 5 per cent carbolic solution for ten hours, but succumb when acted upon for fifteen hours. The addition of .5 per cent HCl to the carbolic solution will kill the spores in two hours. In a solution containing one to one thousand bichloride of mercury, 5 per cent carbolic acid and .5 per cent hydro-chloric acid, the spores are destroyed in five minutes. The tetanus bacillus produces gas in media containing sugar but not in acid. It forms sulphuretted hydrogen abundantly, and a little indol. It produces powerful toxins which can be separated from the cultures by filtration. These are tetanin and tetanotoxin. Brieger and Frankel have also isolated from culture products an intensely poisonous toxalbumin. Of these toxins, one, tetanin, causes the characteristic symptoms of tetanus; another causes tremors, convulsions, and

subsequent paralysis; a third causes at once intense clonic and tonic spasms; the tetanus bacillus remains localized in the part of the body to which it has been introduced, and does not invade other parts. The symptoms are caused by the toxins. It is extremely seldom that the tetanus bacillus enters the blood or reaches remote organs; such cases have been recorded in literature but five times, and so it becomes possible to stop the progress of infection by removing the infected tissues. Furthermore there are few, if any, fatal infectious diseases in which the number of bacteria are so small, for it is often difficult to demonstrate them with the microscope in the wound secretions or the tissues.

Pathology.—The disease is characteristically and purely toxic in nature, and without typical or constant morbid anatomical changes. Congestions occur in different parts, and perivascular exudations and granular changes in the nerve cells have been found. The condition of the wound is variable. The nerves are often found injured, red and swollen. There seems to be little doubt that the chief poison produced by the tetanus bacilli has a specific affinity for the ganglion cells of the anterior horns of the cord, with which it unites with such great firmness that it cannot readily be separated. From the experiments of Meyer and Ransom it would seem that tetanus toxin does not reach the spinal cords through the blood stream, but by slowly passing along the axis cylinders of the motor cells from their terminations. This would explain the length of time that elapses after its injection before the appearance of the first symptoms. Apparently the myelin sheath acts as a quite impervious membrane, and the toxin enters at the end of the neuron, where it is not provided with this sheath. Sensory nerves do not transport the toxin to the cord. The toxin enters the nerve endings from two sources; the first is at the site of the infection, where the toxin is most concentrated, and this probably explains why tetanic spasms frequently begin in the vicinity of the infected parts or are most marked at this point. The rest of the toxin is taken up by the blood and lymph and distributed, to enter the motor endings in small quantities all over the body, and by passing along the motor fibers to enter the cords diffusely, leading to the generalized spasms. The latent period that elapses after injection of the toxin, before symptoms, is occupied by the passage of the toxin along the motor fibers to the spinal cord. If the toxin is injected directly into the spinal cord, symptoms appear at once. This also helps to explain the rather long incubation period observed in human tetanus, which is usually five or ten days. The first part of it is occupied by the growth of the bacteria and production of the toxins, the rest by the passage of the poison along the nerves to the cord. The antitoxin evidently follows the same route, and in clinical cases seen after tetanus has begun the antitoxin is a considerable distance behind the toxin in reaching the ganglion cell, which must have much influence in determining the results of the treatment.

Symptoms.—After an injury the period of incubation varies considerably—from ten days to two weeks. The onset is gradual, with soreness and stiffness in the muscles of the neck and jaw, until at the end of from one to three days the mouth cannot be opened (trismus or lockjaw). This muscular rigidity or tonic spasm extends to the muscles of the face and trunk, in less degree to those of the legs, while the arms are often exempt. The "risus sardonicus" is generally present, and there may be opisthotonos or some other fixed position. An aggravation of the spasms, which may have somewhat relaxed, is produced by any sudden stimulus, such as a loud noise, a draft of air or an attempted movement. These spasms are always continuous, never intermittent. Some patients complain of great pain; others of none whatever.

The mind usually remains clear throughout. The temperature, in mild cases, may be but little raised. Usually it reaches 104 or 105 degrees Fahrenheit; sometimes as high as 108 degrees Fahrenheit during life, and it often rises a degree or two after death. The body is bathed in sweat, the urine is scanty and often albuminous. Death may occur within twenty-four hours from the outbreak of the disease, or not for four or five days.

Prophylaxis.—It is evident that the treatment of tetanus must be prophylactic, for but a very small percentage of recoveries has occurred, apparently under 5 per cent, in spite of quite general use of antitoxin. It has been well said that the patient who is just showing tetanic symptoms is not beginning to have tetanus, he is beginning to die from it. The spasms of tetanus are practically the death agonies of an infection that has existed for several days before their onset, and experience has shown that tetanus antitoxin is then of but little value. Surgeons who have carefully cleansed and drained blank-cartridge and firecracker wounds have had but few cases of tetanus. Surgeons who have also given antitoxin while the wound was fresh have had none. We are accustomed to consider on good grounds the ninth day of incubation as the turning point in estimating prognosis in traumatic tetanus. Cases with a shorter duration than that seldom recover, whereas the more prolonged the onset is, after the ninth day, the better the outlook. By far the majority of boys with "Fourth of July tetanus" have not only completed the incubation before that time, but have completed the disease and are dead. An incubation of from four to five days, with a duration of the disease of twenty-four to seventy-two hours, is frequent. Recovery is remarkably rare. As the mortality from tetanus is observed about the time of the national celebration on the Fourth of July, it naturally follows that in the prophylaxis this important factor should not be omitted. The prophylaxis of tetanus may be considered under five heads: First, the enforcement of existing laws regarding the sale of toy pistols and other dangerous toys; second, the enactment of laws by congress, state legislatures and municipalities against the manufacture and sale of toy pistols, blank cartridges, dynamite caps, cannon crackers, etc; third, the open treatment of all wounds, however insignificant, in which from the nature or the surroundings there is any risk of tetanus; fourth, the immediate use of tetanus antitoxin in all cases of Fourth-of-July wounds, wounds received in barnyards, gardens or other places where the tetanus bacillus is likely to be present or tetanus infection to occur; fifth, the injection of tetanus antitoxin as soon as tetanic symptoms become manifest.

During the past few years several physicians with large hospital practice have used antitoxin prophylactically for Fourth-of-July injuries with complete success. Taylor of New York has treated many patients this way without tetanus following. There is not a single instance on record in which a person who had been given antitoxin soon after receiving a suspicious wound has developed tetanus, nor of any harmful results from its injections into persons not infected with tetanus. For prophylactic purposes 10 cc. should be injected in the same manner as diphtheria antitoxin, but in the vicinity of the wound, if possible; and, according to Meyer and Ransom, best into the muscle, if the wound is in the fleshy part. This should be done immediately after the wound is cared for, if antitoxin is at hand, but if not, it can be used with profit at any time that it can be obtained within the next few days, since the period of incubation is so long.

The demonstration of bacilli by the microscope would be indication for the most vigorous use of antitoxin for several days, until the period of danger is

past. In all cases in which the wound is or becomes infected with bacteria, a second dose of the same size should be injected three or four days later. Only in simple cases, with perfectly clean wounds, should one be satisfied with a single injection. If the patient is under eight years, 5 cc. doses should be adequate.

The nature of blank-cartridge wounds is primarily explosive. The chief damage is done beneath the skin, and the distance to which the injury extends is unbelievable unless one is familiar with these injuries. The size of the channel formed by the explosion is usually smallest near the skin, and enlarges for some distance into the deeper tissues until the wads are reached, and there spreads laterally in a mass of bruised and lacerated tissue, blackened by fire and powder. The surgical treatment of the wound must therefore be most thorough. Safety demands that every part into which dirt from the surface can have been blown be cleaned out and so packed that air can enter and wound secretions escape. This requires anesthesia and careful dissection. Cauterization is not to be recommended, for if the bacteria are not entirely removed, we seal them in most effectually.

Prognosis.—The *Journal* gives the mortality as 95 per cent in Fourth-of-July tetanus. Several different authorities give it from 70 to 90 per cent. The shorter the incubation, the more serious the case; if it be only two, three or four days long, the case will almost certainly be fatal. Any rise of temperature is ominous, and the higher it is the less likely the patient is to recover. Rapidity of pulse and respiration is also a bad sign. The least dangerous cases are those in which the spasm remains localized in the jaw and neck muscles. The number and the violence of the spasms bear a direct relationship to the severity of the disease.

Treatment.—The treatment suggested in the *Journal of the American Medical Association* of June 18th of this year covers all treatments suggested by other sources, so I will give it verbatim:

As soon as possible after the patient is seen general anesthesia should be produced, and the wound cleaned out most carefully in order to put an end to further formation and absorption of toxin. Every shred of necrosed tissue should be removed. Free drainage and access of air should be secured by loose packing with iodoform gauze. Antitoxin should be administered. By far the best results that have been recorded seemed to have been obtained by those who have injected the antitoxin into the spinal canal. As tetanus affects particularly the anterior horns of the spinal cord, this seems to be more logical than the intracranial injection, and it has the great advantage of not adding a considerable operation to the already critical condition. The method used is to introduce the needle of the antitoxin syringe into the sub-arachnoid space by passing between the third and fourth lumbar vertebrae. The cerebro-spinal fluid should be permitted to escape up to 150 drops. This fluid is more toxic than the blood serum. The syringe containing 10 to 15 cc. of antitoxin should be attached to the needle, and its contents slowly injected, allowing at least five minutes for the process. This should be followed by injection with a fine needle of as much as possible of the antitoxin into the substance of and along the course of a large nerve trunk, preferably the one supplying the injured part. This method is based on the newer observations concerning the paths by which the antitoxin reaches the spinal cord; and lastly, still another 10 cc. may be injected in the vicinity of the wound. Elting reports a case in which he gave altogether 1,300 cc. (about three pints), with recovery. After the operations and injections, a subcutaneous saline infusion is desirable, because much fluid is needed by the patient, and it is a difficult matter to feed him without adding to the source of irritation. The patient should then be placed in a quiet, darkened room, with deadened floor, and complete plugging of the ears is advantageous. Every possible means should be taken to avoid any disturbance which may start up spasms. For this purpose morphin, chloral and bromids should be exhibited, sufficient, if possible, to keep the patient stupid. For the first twenty-four hours feeding should be limited as much as possible for the same reason, but after that time it needs to be pushed, as there is great exhaustion. The nourishment must be liquid, and usually has to be fed through a tube. Rectal alimentation is valuable if it can be given without too great disturbance. The subarachnoid injection, always preceded by the withdrawal of cerebro-spinal fluid, the

introduction of 10 cc. subcutaneously, and the saline infusion should be repeated every twenty-four hours as long as indicated. Bacelli's carbolic acid treatment is used by the Italians particularly, but has had quite general application. It simply consists in injecting subcutaneously 1 per cent carbolic acid solution, in sufficient quantities so that about five grains of the acid is given an adult during twenty-four hours. Dr. S. A. Matthews has published a method of treatment by a special salt solution that is very effective in experimental animals. He calls it producing cell catharsis. It produces most profound diuresis. The formula is:

Sodium chlorid	55.5 grains
Sodium sulphate	155.0 grains
Sodium citrate	51.0 grains
Calcium chlorid	2.0 grains
Water	2 pints

This may be injected intravenously very slowly, not over three drams per minute in quantities up to one pint at each infusion, which should be performed twice the first twenty-four hours and once each succeeding twenty-four hours. The profound diuresis that this solution produces must have greater or lesser beneficial effect, and it is probable that the calcium reduces the muscular spasms.

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INNERVATION OF THE HEART AND USE OF CARDIAC STIMULANTS IN TREATMENT OF SHOCK.*

By O. O. WITHERBEE, M. D., Los Angeles.

THE NEED of more satisfactory measures for the care of patients suffering from shock has long been felt by physicians, and an attempt to meet the demands has in many cases been made with, perhaps, as little consideration of the true physiological derangement as is usual in the treatment of the most obscure maladies.

The term "shock" is an expression for a group of clinical symptoms the result of failure of important functions of the body, such as circulation, respiration, excretion and secretion and general metabolism. It is intimately associated with the nervous mechanism. The phenomena of "shock" are complicated, and open a wide field for experimental work. It is not my intention, however, in this article, to discuss a line of experimental research, but rather to cite a few facts; that is, as far as facts may be considered from a physiological standpoint.

It is known that the heart possesses the power of independent pulsation; that its contraction is not effected primarily by nerve energy. The nervous system, however, exercises to a marked degree control of this organ, and it is only under circumstances of an exceptional character wherein the mental or physical condition is violently disturbed that this role of subordination is for a time thrown off. Two important sets of nerves are concerned in the regulation and control of the heart. Those derived from the tenth cranial or pneumogastric exercise an inhibitory influence, while those from the three uppermost ganglia of the sympathetic accelerate the contractions of the heart and, at the same time, augment their force. Physiologists have also undertaken the demonstration of a similar mechanism contained within the heart itself, in the form of the intracardiac ganglia, attributing to these structures the very important function of automatism. The most we could hope to realize from isolated collections of nerve tissue of this character would be reflex action; but here it is evident there is no probability of a complete reflex arc. The transition from the afferent to the efferent fiber of a reflex arc, so far as we know, never takes place in highly organized animals except through a nerve plexus. In the peripheral ganglia the nerve cells appear to give off no branches that form a plexus around them. They seem to be trophic cells

interpolated in the course of the fibers whose nutrition they govern, or stations at which nerve fibers break up for their terminal distribution, not junctions through which impulses may be shunted from one kind of a fiber to another.

The sympathetic ganglion cell may, indeed, have several processes, but one of them is the axis cylinder of a medullated fiber that comes to it from a higher center, and the other the axis cylinders of, it may be, five or six non-medullated fibers passing from it to their destination. Here there is no anatomical foundation for a reflex arc, and the most careful physiological experiments have failed to demonstrate any reflex function in the sympathetic ganglia. Argument in defense of the function of this nerve apparatus of the heart has been presented on the ground that the latter, when removed from the body, or deprived of all the nerves passing to it, still continues to beat for a time, and, in cold-blooded animals, even for a day. Engelman has called attention, however, to the fact that in the foetus pulsation of the heart begins at a period when the latter is still absolutely devoid of nerve cells and, consequently, of nerve fibers. In the human embryo the first beginnings of cardiac ganglia are not found before the end of the fourth or commencement of the fifth week, while Pfluger has seen regular pulsation of the heart in a human embryo of hardly three weeks, which denotes purely a myogenic action entirely independent of any nerve influence.

If, then, we grant the power of independent action on the part of the heart and yet subject it functionally to the control of the nervous system, we must expect to meet with a variety of conditions calling for therapeutic measures in our experience with the derangements of the circulatory apparatus.

Faulty circulation means primarily an incompetent heart, yet the organ in itself may or may not be deficient. Certainly the same remedy will not meet the indication in every instance. If the governing power of the nervous system is for a time withheld, we must temporarily substitute its action as best we may, and endeavor, in some rational manner, to restore its influence. Our line of treatment must depend on the condition to be met, and certainly must vary according to the nature of the derangement we have to overcome. If the centers are merely depressed and not exhausted, stimulation will arouse them. If, however, their excitability is greatly reduced from overstimulation or lack of tone, the result of prolonged or violent irritation, then we may expect that anything short of rest or recuperation will merely intensify the condition, thus leaving our patient in a worse state than we found him.

Direct violence in the vicinity of the solar plexus produces a paralyzing effect which is communicated to auxiliary plexuses, resulting in vasomotor paralysis of all or a greater part of the vessels of the abdomen. In order to compensate for this loss of function, the heart must increase its labor to a very great extent. With pronounced shock to the solar plexus we have paralysis also of the inhibitory nerves. The disastrous results following such a condition are characterized by a heart running at random, wild and erratic, without any control. The organ is then virtually severed from its controlling influence, and to reach it through the nervous system is, for the time being, absolutely futile. When the vasomotor center is exhausted, stimulants such as strychnia (the action of which is confined entirely to the spinal cord) are either valueless or harmful, because if the center is exhausted, strychnia can have no effect, and, if partially exhausted, the stimulation will be followed by a deeper depression.

Shock may be as readily induced by vasomotor stimulants as by injuries or operations; both are stimulants in a way, and neither can be employed with advantage in the treatment of shock produced

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